

ECOLOGY AND BEHAVIOR OF THE GALAPAGOS RAIL

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During his famous visit to the Galápagos Islands in 1835 Charles Darwin observed "great numbers of a very small water rail . . ." (Darwin 1896). This bird was *Laterallus spilonotus*, a species endemic to 7 islands of the Galápagos archipelago. Early studies of the Galápagos Rail (local name, "pachay") concentrated on taxonomy; despite the local abundance and relative tameness of this species, the information available on its ecology and behavior has been only anecdotal. We report here the results of a 10-month field study of this little-known bird.

METHODS AND STUDY AREAS

Ecological and behavioral data were gathered during approximately 150 person-days of field study (principally by ABF) between September 1973 and July 1974, on Santa Cruz Island, Galápagos, Ecuador. The 2 main study areas were in the highland regions. The Media Luna site (elevation 600 m) was in the vegetational zone of *Miconia robinsoniana*, a 1-3 m endemic shrub (zone nomenclature follows Wiggins and Porter 1971). This site included dense shrub areas with fern undergrowth, and open sedge-fern meadows. The Puntudo site (elevation 730 m) was in the open fern-sedge zone near the island summit.

The climate in the Galápagos Islands is biseasonal, with great variability among years. In the highlands the "hot season" (ca. January through May) is generally hot and sunny with sporadic heavy rains. The cool season (locally termed the "garúa season") extends from about June through December; day-long rain, drizzle, and fog are common.

Chicks were captured by hand or with a net; for larger birds the only effective method was to use a chicken wire box-trap propped up on 1 side. All captured rails were color-banded, and the following data recorded: weight (± 1 g); length of exposed culmen, middle toe with claw, and tarsus (± 0.1 mm); eye and bill color; and condition of plumage. Gut contents were aspirated from 6 individuals, and fecal samples were collected when located in the field.

Galápagos Rails were exceptionally tame and could be followed by an investigator crawling on hands and knees. Movements of individuals were mapped by triangulating marked locations of sightings. Rail calls were recorded on a portable cassette tape recorder and subsequently transferred to reel-to-reel tape. Sound spectrograms were made with a Kay Elemetrics Missile Data Reduction Spectrograph (and a Uher 4200 tape recorder), using a 200 cps wide band filter. Playbacks of these calls (on the original cassettes) were used to observe reactions of rails and Short-eared Owls (*Asio flammeus*).

ECOLOGY

Distribution and habitat.—The Galápagos Rail originally occurred in 2 habitat types: highland moist regions with dense ground cover, and coastal

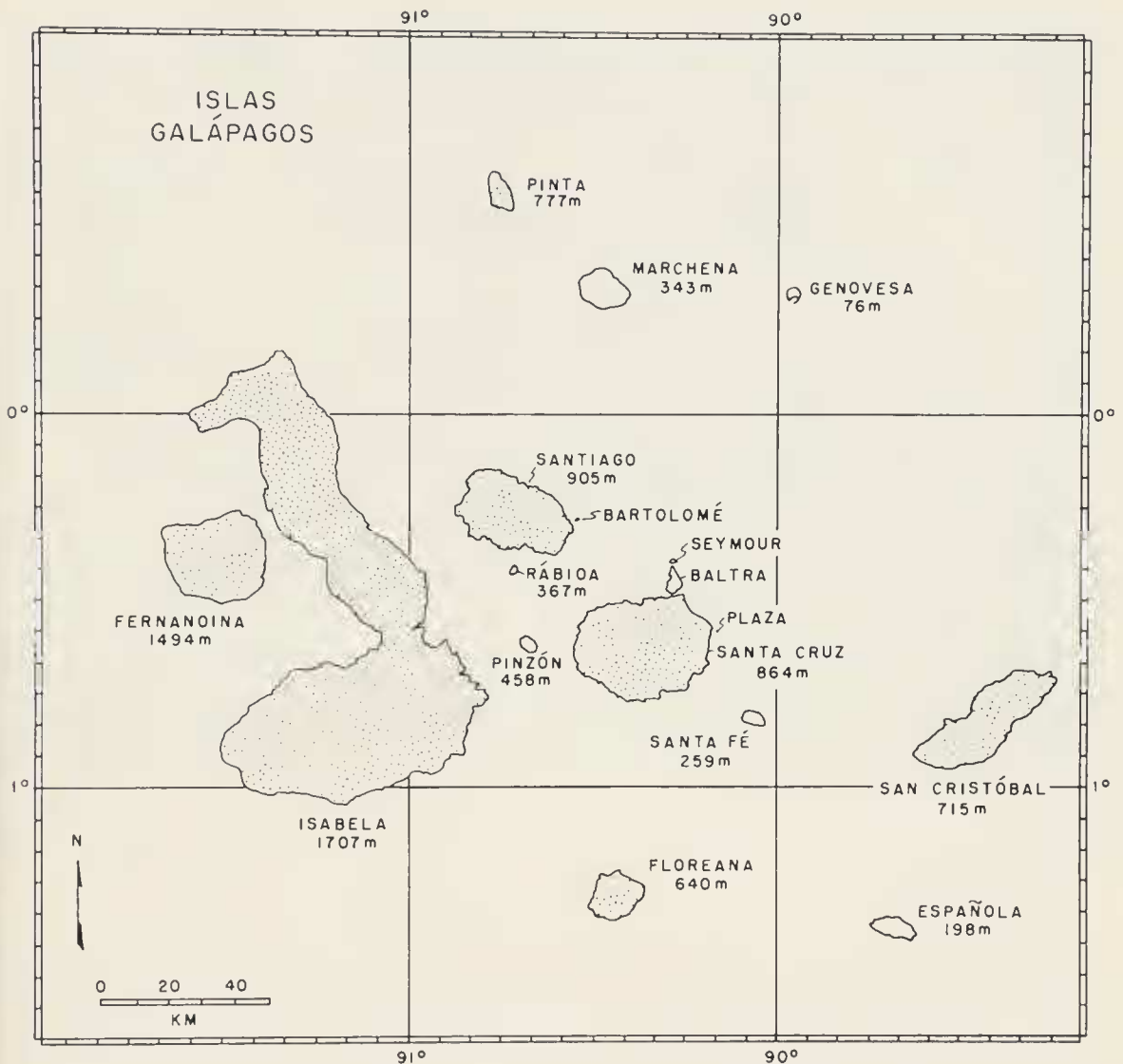


FIG. 1. Current island distribution (stippled) of *Laterallus spilonotus*. All islands higher than 500 m have rails.

mangrove zones (Salvin 1876, Rothschild and Hartert 1899, Snodgrass and Heller 1904, Gifford 1913). The species is no longer known from mangroves on any island. The reason for this habitat shift is unknown; Michael Harris (pers. comm.) has noted that exotic animals are unlikely to be a sufficient explanation, because rails seem to have disappeared from the mangroves of Fernandina, an island with no introduced predators or competitors.

L. spilonotus is now known only from those islands high enough to have an extensive moist region (Fig. 1). The rails' close association with the dense moist zone vegetation is illustrated by records from Pinta Island, where these birds were common in the fern belt of the highlands (Castro 1964, Charles Darwin Research Station 1968). Goats were introduced to Pinta in 1959; between 1968 and 1970 they moved into the moist region, clearing it

TABLE 1

BREEDING RECORDS FOR *LATERALLUS SPILONOTUS*, SANTA CRUZ ISLAND, GALÁPAGOS

Month	No. of nests with eggs or nestlings*	No. of broods with chicks**	No. of broods with juveniles
Jan-Feb	4	4	1
Mar-Apr	3	3	1
May-June	—	—	2
July-Aug	—	—	—
Sept-Oct	—	3	—
Nov-Dec	2	3	—

* 6 nests (Tui De Roy pers. comm.)

** 1 brood (Gil De Roy pers. comm.); 1 brood (Tui De Roy pers. comm.); 1 brood (Chapin 1930); 2 broods (Edinburgh Expedition 1968), both eited as "young" (chicks?); 1 brood ("small young") (Craig MacFarland pers. comm.); 1 brood (Henk van der Werff pers. comm.).

of all vegetation except trees and some shrubs (Weber 1971). During 2 visits to Pinta in 1970, no rails were seen or heard (Kramer and Black 1970). Beginning in late 1971 the Galápagos National Park Service instituted a goat-hunting program. With the consequent great reduction of goats on Pinta, the undergrowth has returned. Tjitte de Vries (pers. comm.) found rails "common" on the island summit during 2 visits in 1973-1974.

On Santa Cruz, we have seen and heard rails in the following zones (described in detail in Wiggins and Porter 1971): the *Scalesia* forest (north and south slopes); the shrubby *Miconia* zone; the fern-sedge zone around the summit; and the moist farming regions. During 60 days in the much drier Transition zone we observed no rails.

Reproduction.—The few nest and brood records from Santa Cruz (Table 1) are from the months of September through April. Additional evidence of reproduction is scarce. Amadon (in Lévêque 1964) collected 2 males with enlarged gonads on Santa Cruz in April 1930. Gifford (1913) noted "somewhat enlarged" gonads in specimens taken in November 1905 (Santa Cruz) and January 1906 (Santiago). He also recorded a female with a well-developed egg and 2 other birds with enlarged gonads, all taken in September 1906 on Pinta. In June 1974 we observed 1 pair of Santa Cruz rails apparently courting (bill fencing, mutual preening). More breeding records, correlated with seasonal conditions, are necessary to describe reproductive patterns adequately.

Three *L. spilonotus* nests that we examined were deep semi-domed cups with a side entrance. Made of herbaceous stems, they were built on the ground and covered by dense, low vegetation. This nest construction cor-



FIG. 2. Pair of Galápagos Rails at change-over during incubation (photograph by Tui De Roy).

responds closely to that described for the Black Rail (*Laterallus jamaicensis*) (Clark 1884, Bent 1926).

The eggs were beige, with red-brown and some gray speckles (0.3–1.0 mm) sprinkled over most of the surface, particularly at the wide end of the egg. Three eggs from 1 nest measured 29.1×22.2 , 29.0×21.6 , and 30.2×21.5 mm (measured with calipers). Five eggs from another nest measured (with a ruler and thus less accurately) 28×20 , 25×20 , 26×20 , 25×19 , and 26×19 mm.

Eggs of the other small rallid of Santa Cruz, the Paint-billed Crake (*Neocrex erythrops*), are similar in size and shape to those of *L. spilonotus*. Paint-billed Crake eggs are cream-colored and flecked with red-brown and gray spots, clustered at the large end. These spots are mostly 1–3 mm, but some are as big as 6×10 mm. Three eggs from the only *Neocrex* nest we found measured 32.6×23.7 , 32.5×23.8 , and 33.9×24.0 mm; the nest was a low open bowl with no dome or roof, quite different from a *Laterallus* nest.

We found 1 Galápagos Rail nest with 3 eggs on 19 November 1973. On 13 December there were 2 dry young and 1 egg, giving a minimum incubation period of 23–25 days. The third egg never hatched.

In January 1975 Tui De Roy (pers. comm.) observed a pair of *L. spilonotus* incubating. The pair exchanged duty on the average every 50 min during several hours of observation. Each change-over included several minutes of mutual preening, with both members sitting in the nest (Fig. 2). The foraging birds seemed to remain within 10–15 m of the nest.

Data for clutch and brood size are limited. Six clutches of 3 to 6 eggs and 3 groups of 2 to 4 chicks on the nest have been found (Tui De Roy, pers. comm.; our observations). We saw numerous broods, but in the dense vegetation it was often difficult to count the chicks accurately. Seven broods of 1 to 5 young ($\bar{x} = 3.6$) have been recorded (Gil De Roy, pers. comm.; our observations).

One banded adult was associated with 2 broods in 1 season. On 13 and 14 February 1974 this bird was seen with 5 chicks. Two chicks (weights 20, 24 g) were banded; on 9 March one of these was recaptured (it then weighed 36 g). On 19 March the same adult was seen with a brood of at least 3 obviously newly-hatched chicks (the 2 captured weighed 13 and 14 g).

Growth and development.—Fig. 3 depicts the changes with increasing body weight of several external characters (data from 26 Galápagos Rails, captured 31 times). There is a progressive change of iris color from black through brown and orange to crimson as these birds mature (a very similar progression in iris coloration has been illustrated in color by Rowley [1974] for the White-winged Chough [*Corcorax melanorhamphus*]). Bill coloration also changes through development. As in Black Rails (Walker 1941), the bill of very young Galápagos Rail chicks is completely white over the proximal half, and is black on the tip. The area of the white patch decreases with age, contracting from the sides and from below. Once rails weigh ca. 28 g, the white area is only a small spot halfway along the culmen; the bill is completely black for all birds over ca. 37 g. Plumage coloration also changes with size in Galápagos Rails. An increasing portion (up to $\frac{3}{4}$) of the back becomes fuscous, and the white spotting increases, spreading out over the body and wings.

Regressions of the length of the tarsus, exposed culmen, and middle toe (with claw) on body weight are given in Table 2. While the first 2 measurements increase linearly with body weight, the increase of the middle toe is logarithmic, showing much more rapid growth in earlier development.

Because we did not autopsy birds, we could not correlate external characters with reproductive state; therefore we divided the rails arbitrarily into 3 “age” groups, as indicated in Fig. 3. The few intermediate birds were classified according to bill coloration. Although we based these groupings solely on external morphology, we found distinct behavioral differences

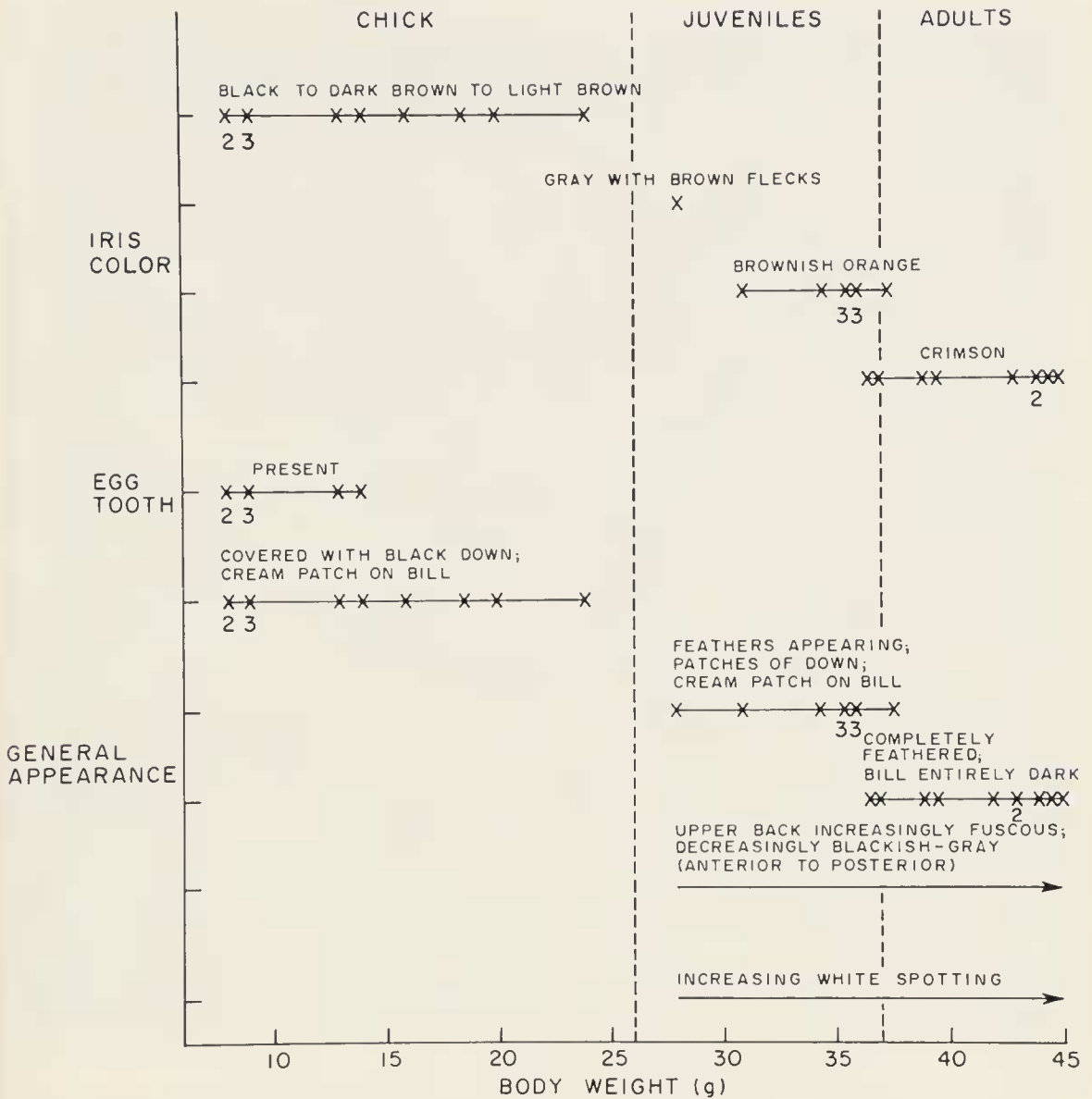


FIG. 3. Developmental changes of external characters in *L. sillonotus*. Subscripts indicate more than 1 individual.

between "juveniles" and "adults" (see Behavior). Non-"adult" birds were never seen exhibiting breeding behavior.

The data from all banded bird sightings and recaptures indicate that the transition from newly-hatched chick to "adult" requires 80–85 days. One individual, captured as a 9 g chick in December 1973, was observed with a mate and 4 young in December 1974 (Tui De Roy, pers. comm.).

Growth rates obtained from 4 recaptures were (with initial weight, final weight, and time between captures): 1.5 g/day (14–18.5 g, 3 days); 0.83 g/day (28–35.5 g, 9 days); 0.67 g/day (20–36 g, 24 days); 0.26 g/day (16–36.5 g, 78 days). From these data we infer that the growth rate is

TABLE 2

RELATIONSHIP OF 3 EXTERNAL MEASUREMENTS TO BODY WEIGHT (G) OF FREE-RANGING GALÁPAGOS RAILS

Dependent variable	N	Regression ¹	r
Tarsal length (mm)	26	$y = 12.88 + 0.27x$.88***
Culmen length (mm)	29	$y = 4.46 + 0.28x$.97***
Length of middle toe with claw (mm)	29	$y = 2.07 + 18.02\log_{10}x$.82***

¹ Model II; calculations follow Sokal and Rohlf (1969:483).

*** P < 0.001.

initially rapid and then slows markedly as a bird reaches approximately 36 g.

Diet.—Field observations and analysis of 5 gut and 10 fecal samples indicate that Galápagos Rails eat primarily invertebrates. We identified the following food items (with total number of samples or observations in which the item occurred): dragonflies, 3; moths, 4; hemipterans, 7; ants, 1; spiders, 2; isopods, 1; amphipods, 1; snails, 1; and seeds, 4 (the ant and amphipod were very small and may have been incidental items). Fragments of arthropod exoskeleton were present in 4 of the gut samples and in all the fecal samples. Although we never observed rails eating plant materials, 1 stomach (from a Santiago juvenile) was approximately half-full of seeds from an unidentified solanaceous berry. Several seeds of *Miconia robinsoniana* were found in 1 gut sample. Another contained a few seeds of *Paspalum conjugatum* (Poaceae); these seeds are very adherent and may have been picked up in preening.

Predation.—Our single observation of a domestic dog killing a rail is the only record of predation on *L. spilonotus*. The Short-eared Owl, a known predator on the Black Rail (Huey 1926), commonly hunted in both our study sites. We observed individual owls flying toward and hovering over the area when they heard either taped rail calls or vocalizations of actual rails; however Abs et al. (1965) did not find remains of *L. spilonotus* in their study of Galápagos Short-eared Owl pellets.

Although black rats (*Rattus rattus*) were abundant at Media Luna (15/ha, Clark and Clark, pers. obs.), they appeared to have little or no effect on the rails, for *L. spilonotus* was common there. Rat predation on rail eggs may be prevented by the incubating adult's aggressive behavior towards intruders. While we were investigating 1 nest, the attending rail stayed in or very near the nest (Fig. 4a). It also actively defended the eggs, once by spreading its wings over the nest entrance (Fig. 4b), and once



FIG. 4a. Adult Galápagos Rail inside nest entrance.

by sharply pecking the investigator's hand as he reached toward the eggs. The 2 other nests observed, however, were not defended.

BEHAVIOR

We found Galápagos Rails active throughout the day (twice calling was also heard at night). Provided the observers remained still, they foraged calmly around us, often passing a few cm away without apparent disturbance. At times individuals circled and peered at us, seemingly very curious. Even when disturbed by sudden movements, birds sometimes returned after fleeing only a short distance.

Terrestrial locomotion.—Although Galápagos Rails occasionally fly and swim, they are basically ambulatory. When startled, they usually run



FIG. 4b. Same adult displaying above nest entrance.

rather than fly. Marked 9-g and 13-g chicks held their stubby wings out to the side as they ran. Movements were clumsy at this size, but the 13-g chicks were fast and not easy to capture. Older birds (≥ 20 g) hold the wings close to the sides: the body and head are low to the ground as the rails run along a zig-zag pattern. The birds always seem to keep close to protective cover. When observed crossing open patches of ground, individuals always ran, either directly across or in rapid dashes with a pause of a few sec between each spurt.

Gifford (1913) observed that *L. spilonotus* on Santiago "traveled through little runways in the grass." In our Puntudo study area, such small beaten-down trails were very numerous under large patches of bracken (*Pteridium aquilinum*) and were usually strewn with droppings. No trail maintenance was ever observed. Rails were regularly seen using the runways, which probably facilitate walking through the dense *Pteridium*. Ten captures in 10 days (2 adults and 6 juveniles) were made with a box-trap set in the same location on one runway.

On 2 occasions juveniles were seen climbing 0.5 m above the ground, one in a *Miconia* bush and the other in a mat of dead ferns. Both seemed fairly adept at moving up and along stems and branches, often stepping from one to another. One bird fed while hanging upside-down from a fern. An adult

kept in a cage easily walked up the sides, grasping the wire mesh with its feet. Twice we observed Galápagos Rails swimming in small pools at Media Luna.

Flight.—We have 13 observations of individuals flying short distances; 6 of these were of birds flushed by the observer in open meadow. These individuals flew an average of 8 m (1–30 m). One hovered for a few sec 2.5 m above the ground in front of a mist net before flying off. When another individual was chased toward a low mist net under the *Miconia*, the bird flew 0.5 m over and 1 m beyond the net. Several times birds feeding under *Miconia* were seen to fly 1–3 m across pools and resume feeding on the opposite bank. Galápagos Rails fly with the legs hanging down. Flight appears very labored and the landing is rather awkward (Griscom [1915] described similarly weak flight for Black Rails). Once a captured adult was released by tossing it about 6 m up in the air; instead of flying off, the bird fluttered to the ground and landed heavily (uninjured) in a patch of ferns.

When Gifford (1913) compared morphological measurements of 79 Galápagos Rails and 9 Black Rails, he found that the Galápagos species had proportionately shorter wings and tail. Olson (1973) has argued that reduced powers of flight could be expected to develop in rails that colonize islands. About ¼ of extant or recently extinct rallids are flightless, and all of these are from oceanic islands (Olson 1973).

Types of vocalizations.—The Galápagos Rail has an extensive repertoire of vocalizations, including cackles, clucks, warbles, trills, and hissings, but most fall into 1 of 5 categories.

(1) Cheeping.—Chicks and juveniles in family groups cheep constantly; the rate varies from about 3 per sec to 1 every 4 sec. Once, 2 independent juveniles were seen feeding and cheeping together. Cheeping young are heard easily but are difficult to locate precisely.

(2) *Chichichirroo* call. This call sometimes includes an introductory phrase (1–5 sec) of several harsh, squeaky *chuh-chuh-chuh* syllables (Fig. 5a). The *chichichirroo* segment of the call (Fig. 5b) lasts approximately 1 sec and is usually repeated several times. The *chichichichi* syllables are rapid but distinct and at the same pitch. The *rrooo* is a quick falling slur.

There is a striking similarity between this call and the *kic-kic-kerr* call of the Black Rail (see sonagrams in Kellogg 1962 and Reynard 1974). Both begin with a group of equal, distinct notes (2 or 3, in the Black Rail: 5 or 6, in the Galápagos Rail), and both end with a descending slur.

The *chichichirroo* call seems to be the territorial advertisement call of the Galápagos Rail. It is one of the most frequently heard calls, and it carries well for distances of several hundred meters. It is the only *L.*

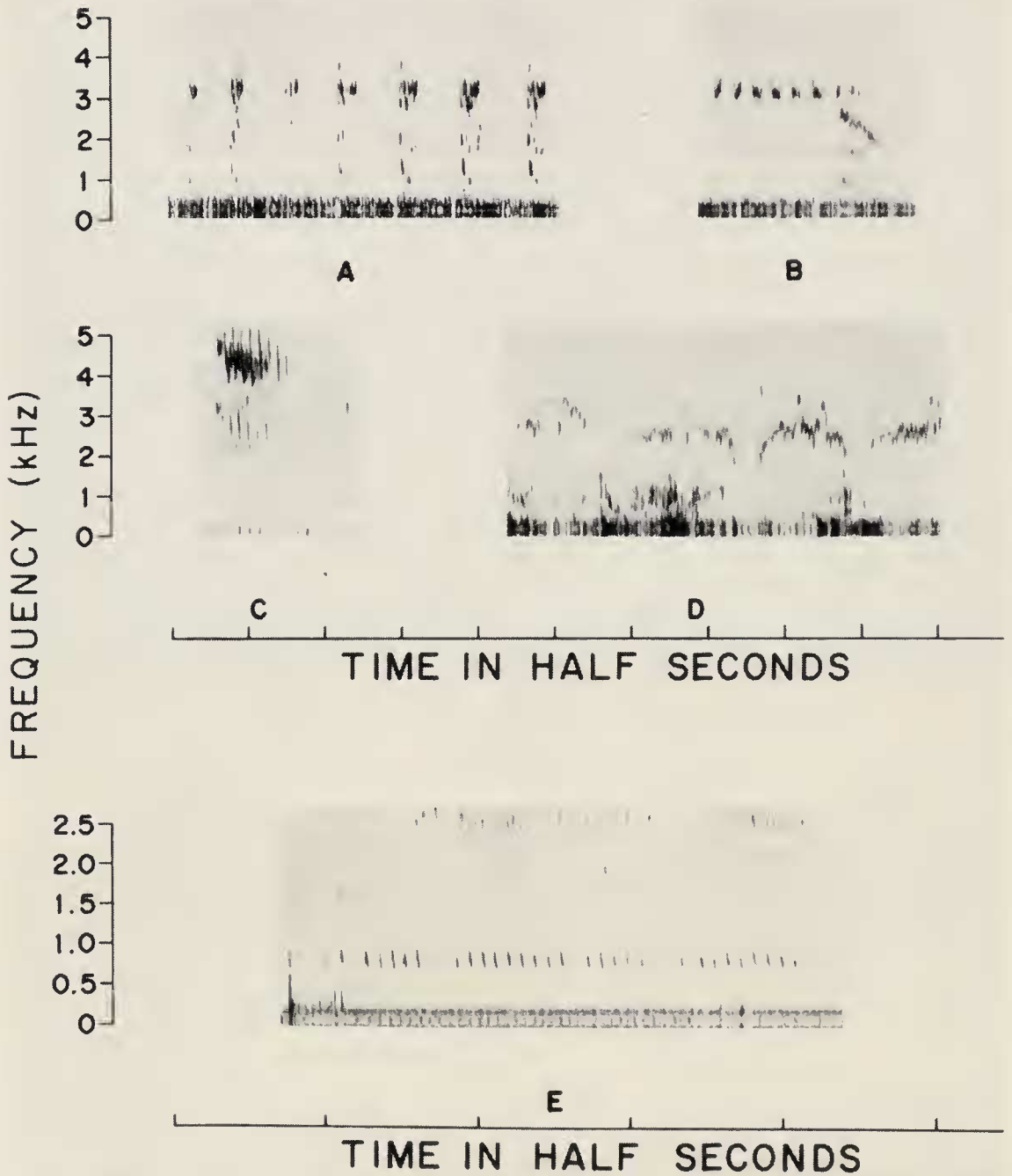


FIG. 5. Galápagos Rail vocalizations. *Chichichirroo* call: A. introductory syllables, B. main phrase; C. *chirr* call; D. "chatter" call; E. "rattle" call.

spilonotus vocalization we heard that does not seem to vary in its pattern. The only birds seen giving this call were adults.

(3) *Chirr* call (Fig. 5c). This call is a short (1 sec) descending trill, sometimes followed by 1 or 2 attached *chah* or *tah* syllables. We heard this call most frequently during the hot season, and recorded it only a few times in the cool season. Once a long sequence of *chirr* calling was followed by an agonistic encounter between adults.

(4) "Chatter" call (Fig. 5d). A low, breathy, wheezy chatter, this call sometimes begins slowly and usually lasts 3–9 sec.

(5) "Rattle" call (Fig. 5e). This call is a rapid, coarse rattle several sec long. One adult seen giving this call had its head pointed up at a 45° angle, with the bill opened slightly; its head and neck vibrated very rapidly as the bird called.

The "rattle" call is often preceded by the "chatter" call, but the latter is frequently heard alone. Only adults were observed giving these 2 calls; these were the vocalizations most frequently heard in response to various taped rail calls. They were also heard before and after the 2 agonistic encounters observed by the senior author.

Foot-stamping display.—The Galápagos Rail uses 2 intensities of a foot-stamping display. Mild foot-stamping consists of a bird remaining in 1 place while alternately raising and lowering the feet in a walking motion. The toes do not leave the ground and the legs are slightly bent. These displays last only a few sec and may be repeated several times, with the bird remaining in the same place or moving between displays.

In vigorous foot-stamping the bird remains stationary and drums the feet, alternately lifting each foot off the ground. The rate of drumming may be fast or slow. The body is tilted forward, held low to the ground, and remains motionless. Bouts of this display are usually longer and repeated more times than bouts of mild foot-stamping. One adult (11 June) performed 12 displays, ranging in length from 10 to 60 sec. Another (8 April) performed 1 display lasting 30 sec. In 6 observations where the position of the tail was noted, it was erect.

Juveniles (3 instances) and adults (8 instances) were seen performing the mild foot-stamping, but only adults were observed performing the vigorous foot-stamping (11 instances). All foot-stamping appeared to be directed at the observer, for the birds always looked at the observer as they displayed. In 2 instances of vigorous foot-stamping a second adult was present (the possible mate; see Adult interactions). In 1 instance a chick was present, and in 2 others an adult had been flushed from its nest. All observations suggest that mild and vigorous foot-stamping are 2 intensities of an aggressive display.

Tail erection display.—*L. spilonotus* often displays an erect tail. When an individual is undisturbed, the tail projects in line with the curve of the body. When the tail is erect, it is cocked at 45 to 90° to the horizontal. Once a bird with its tail erect also fanned the tail feathers in a semi-circle.

If the observer moved suddenly, a rail would flip its tail up as it scurried off. Twice, when individuals were caught in a box-trap, the tail was erect

as each attempted to escape. Quick, jerky movements always accompanied tail erection. The action appears to be an alarm response.

Foraging behavior.—Galápagos Rails seem to feed throughout the day. On the ground, the rails have a very characteristic feeding pattern. When undisturbed they walk with tail down and dart their head to either side. They obtain food only with the bill: no rail was ever seen scratching the ground with its feet. With each dart of the head these birds jab their bills rapidly into the litter, picking up leaves and twigs and tossing or pushing them aside with the bill. They also take items off stems and frequently poke their bills into clumps of moss and other epiphytes on the trunks of *Miconia*. Several times birds were seen standing on tiptoe, jabbing the bill at something on the underside of a dead *Pteridium* frond. Twice we saw rails climb 0.5 m above the ground to forage.

At Media Luna rails frequently forage around pools, streams, and small patches of *Sphagnum* bog. The birds also wade into the water, sometimes breast-deep; they dart their heads at the surface and apparently obtain food there. Once a rail waded to a depth of several cm. picked a dead dragonfly from the surface, and carried it to shore. Generally, however, the items taken from the surface of pools and streams were too small for us to identify at a distance.

Young Galápagos Rails generally obtain their food from their parents. At 2 nests Tui De Roy (pers. comm.) saw adult *L. spilonotus* feeding insects and spiders to chicks in the nest. In 9 of the 10 observations we made of chicks feeding, an adult fed the chick (once a chick picked up something by itself and ate it). Once a chick stooped down in front of the adult, pointed its bill up, and cheeped much faster than normal; it was then fed by the adult. In 1 family, both parents were seen feeding the young; Craig MacFarland (pers. comm.) has also seen 2 adults cooperatively feeding a brood. Juvenile Galápagos Rails forage for themselves: we never observed feeding of juveniles by adults.

Behavior of family groups.—*L. spilonotus* chicks leave the nest soon after hatching. The senior author found 2 dry chicks, 1–3 days old, in a nest he had been monitoring; both chicks ran away into the surrounding grass. The 1 chick captured weighed 9 g. A free-ranging brood examined elsewhere consisted of chicks the same size or smaller (2 weighed 9 g; 2 weighed 8 g).

Once out of the nest, young Galápagos Rails stay with their parents until they are nearly the size of adults. A family with chicks moves as a cohesive group, 1 or both of the parents staying with the chicks. As the group moves, the adults cluck and the chicks maintain a constant cheeping. During approximately 2 h of observation, the formation of 1 family with 5 chicks changed frequently. At times all the chicks were behind 1 adult, the other

parent moving some distance away. At other times the family split into 2 groups, each adult leading 2 or 3 chicks.

When we approached broods of Galápagos Rails, the chicks exhibited a characteristic running and freezing behavior. The parents, however, often remained nearby, circling the area and foot-stamping. On 3 different occasions, a captured chick cheeped loudly, and the parents immediately approached the investigator. Once both parents came right to the investigator's foot and remained there, 1 bird spreading its wings and calling. Another time a single adult approached the investigator in a series of 4 quick bursts of running, each ending with a spreading of the wings and a pronounced hissing call (the only time this call was heard); when the bird reached a point 0.5 m from the author it turned suddenly and ran 3 to 4 m away and repeatedly circled the area. On several other occasions, however, the adults did not approach when captured chicks cheeped loudly.

Compared to families with chicks, families with juveniles move in much looser groups. Large juveniles, like chicks, cheep constantly. A family unit can remain intact even when the juveniles are nearly adult size. Three families with 35–36 g juveniles were seen. Probable dissolution of 1 family group was recorded in 1974. On 5 March a group of 2 adults and 3 large juveniles (1 banded) was seen. Four days later the banded juvenile, which then weighed 36 g, was followed as it foraged with another large juvenile; no adults were observed. This bird was again seen on 24 March, apparently feeding by itself.

Adult interactions.—We observed a number of adult interactions (in the absence of a brood), but we were unable to distinguish sexes or breeding status of the birds. Several observations involved apparently mated pairs. On 11 June an exchange of calls was heard; soon after, an adult rail came into a small clearing and fluttered its wings violently (the only time this behavior was seen). It then entered an adjacent patch of ferns, where it joined a second adult. The 2 subsequently crossed the clearing, one after the other. Six min later the smaller bird brought a caterpillar and gave it to the larger one. Another pair (also seen 11 June) stayed within 3 cm of one another; 1 of these birds repeatedly foot-stamped toward the observer, and both preened vigorously. Then they touched bills and resumed preening. After a short interval the rails stood slightly apart and one preened the other's neck.

We observed 3 instances of fighting between adults. On 12 February, 2 rails were heard *chirr*-calling repeatedly from opposite sides of the ravine at Media Luna. Then, 1 adult quickly crossed the ravine, with its tail up and head down, in the direction of the second bird. A fairly large rail,

presumably the second bird, then walked out of cover, followed by the first (considerably smaller) bird. The smaller one overtook the larger, and a fight ensued, the details of which were not seen. A repeated squeaking was heard, and 1 bird chased the other, attacking it with its claws. The larger bird moved away, and the smaller one *chirr*-called. Eventually the small individual crossed to the opposite side of the ravine and began moving along the bank, calling. Then, what was apparently a third adult flew across the ravine to the small individual, and a short fight ensued.

Fighting was again observed 1 June, after a tape of recorded rail calls was played. Two adults circled the recorder together, giving "chatter" and "rattle" calls before disappearing. Five min after the tape ended, 1 rail appeared at the edge of a small clearing in front of the recorder and looked toward it. A second adult appeared on the opposite edge of the clearing, about 1.5 m away. It hesitated, then moved rapidly toward the first bird. It ran with head down, head and wings held close to the body, and body low to the ground, and rammed the other bird with its bill. Both rails then moved rapidly into cover nearby. They made no vocalizations during the whole sequence.

On 12 September 1975, fighting followed the playing of recorded *chichichirroo*, "chatter", and "rattle" calls. Two different fights occurred, each between 2 birds; loud "chatter" and "rattle" calls followed both fights.

Home range and territory.—Fig. 6 shows mapped movements of adult rails in the Media Luna study area. These records are not strictly comparable among birds. Some individuals were only followed on 1 day, while others were sighted repeatedly over a span of months. Also, the study area was not sampled equally; observation was much easier around the pools. All sightings occurred from January through June (except 1 observation on 14 December). Home ranges may change later in the cool season.

The home ranges of adults, or mated pairs of adults, appear not to overlap. We never observed more than 2 adults foraging together. For only 1 bird (R-Wh) did we obtain an idea of the complete adult home range (Fig. 6). The greatest distance between R-Wh sightings was 132 m. During the 3 months this individual was followed, it raised 2 broods. A juvenile from one of the broods later occupied an area contiguous to the parents' home range. The observed ranges of juveniles were smaller than those of adults.

The possibility of territoriality was investigated using various tape-recorded *L. spilonotus* calls in a series of 31 tests. Responses, mainly "chatter" and "rattle" calls, were elicited in 24 tests. In 10 cases, it was certain that at least 2 rails called. At times the birds called independently:

X=R-Wh ●=R-DB-Wh △=R-DB-Yw ○=R-Rd ▲=Unbanded adults

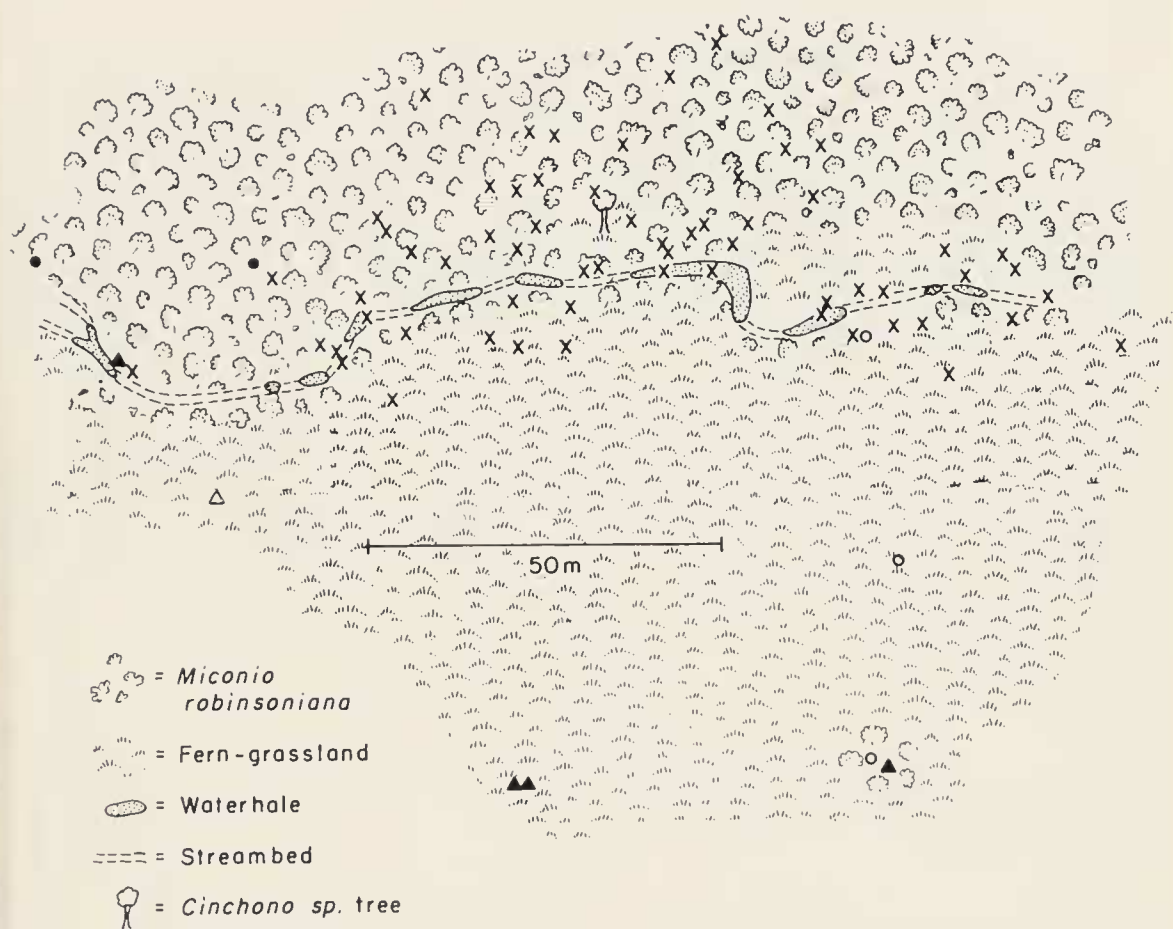


FIG. 6. Mapped sightings of adult Galápagos Rails (the stream bed runs between the west base of Media Luna and an adjacent fern-sedge meadow).

sometimes they called simultaneously, or one began calling and the other joined in. Such duet responses to taped calls have also been elicited from Clapper Rails (*Rallus longirostris*) (Tomlinson and Todd 1973) and Sora (*Porzana carolina*) and Virginia (*R. limicola*) rails (Glahn 1974).

In 11 of the tests, rails approached the recorder; all but 1 were adults. In 3 tests, 2 adults were seen together. Adults generally circled the tape recorder, looking at it or peering from side to side, calling, and occasionally foot-stamping. The 1 juvenile merely looked at the machine. Once a fight occurred between 2 adults shortly after the tape ended. No controls were used, such as playing recorded calls of other species; therefore we do not know if rails responded to the calls themselves or merely to a strange sound in their area.

The home range data and results of these tests suggest that Galápagos Rails are territorial. Possibly both members of mated pairs defend the territory, at least by calling.

CURRENT STATUS OF THE GALAPAGOS RAIL

On Santa Cruz, the population of Galápagos Rails does not seem to be in danger. These birds are fairly common around agricultural lands in the moist area; the only man-produced habitat that appears inimical to them is over-grazed short-grass pasture. The Galápagos National Park now includes most of the remaining *Miconia* belt, *Scalesia* forest, and almost all of the fern-sedge zone; therefore much of the remaining natural rail habitat is protected.

With the exception of Fernandina, all of the islands on which *L. spilonotus* occurs also have introduced mammals. Most of these mammals are potential predators or competitors of the Galápagos Rail (e.g., the goats on Pinta). Rail populations should be censused systematically; an assessment line using tape-recorded rail calls would be the most practical method.

SUMMARY

The endemic Galápagos Rail, *Laterallus spilonotus*, originally occurred in mangrove and moist highland habitats in the Galápagos Islands, Ecuador. Today it is restricted to high moist areas on 7 islands. We report the results of a 10-month field study of this species' behavior and ecology on Santa Cruz Island.

Breeding records extend from the middle of the cool season (September) to the end of the hot season (April). The covered nests have a side entrance and are built on the ground. Recorded clutch-size ranges from 3 to 6; both adults incubate the eggs and feed the chicks. One bird was observed with 2 sequential broods in 1 season. The juveniles have brown to orange irises and a patch of white on the bill; adults have crimson irises and completely black bills. One breeding year-old bird was observed. *L. spilonotus* feeds primarily on invertebrates. The only recorded predation was by a domestic dog.

Galápagos Rails are primarily diurnal and are relatively easily observed. They are basically ambulatory; we saw only occasional short and apparently labored flights. The 5 most common vocalizations are: cheeping (chicks and juveniles); *chichichirroo* call (the probable territorial advertisement); *chirr* call (heard most often in the breeding season); and "chatter" and "rattle" calls (the usual responses to taped calls; also associated with agonistic encounters). Two characteristic displays are foot-stamping and tail erection.

Both parents remain with the young until the late juvenile stage. Adults feed chicks, but all juveniles observed fed themselves. We never saw more than 2 adults foraging together. Adult home ranges appear not to overlap.

The Santa Cruz population seems stable; the effects of exotic predators and competitors on all Galápagos Rail populations should be examined.

RESUMEN

La endémica gallineta galapagueña ("pachay"), *Laterallus spilonotus*, se encontraba originalmente en manglares y en medios altos y húmedos en las Islas Galápagos, Ecuador. Hoy día existe solamente en las zonas altas y húmedas de 7 islas. Se exponen en el presente trabajo los resultados de los estudios efectuados durante 10 meses sobre la ecología y el comportamiento de esta especie en la Isla Santa Cruz.

Existen observaciones de reproducción desde los mediados de la estación de garúa (septiembre) hasta los fines del invierno (abril). Los nidos tapados tienen una entrada a un lado y son construidos sobre el suelo. Nidadas observadas consistieron en 3 hasta 6 huevos; los dos adultos incuban los huevos y dan de comer a los polluelos. Un individuo tuvo dos nidadas sucesivas en una estación. El iris de los jóvenes es pardo o naranjado, y hay una mancha blanca en el pico; el iris de los adultos es carmesí, y el pico es totalmente negro. Se observó un individuo de un año de edad que había reproducido. *L. spilonotus* come principalmente invertebrados. En el único caso observado de predación, un perro domesticado mató un pachay.

Los pachay son principalmente diurnos y se los puede observar relativamente fácilmente. Son básicamente ambulatorios; observamos solamente de vez en cuando vuelos cortos que parecieron penosos. Las 5 vocalizaciones más frecuentes son: el pío (polluelos y jóvenes); el canto *chichichirroo* (probablemente el canto territorial); el canto *chirr* (que se oye más frecuentemente durante la época de reproducción); y los cantos "parloteo" y "traqueteo" (las respuestas comunes a cantos grabados; también asociados con encuentros agresivos). Dos exhibiciones de conducta características son golpes en el suelo con las patas y levantamientos de la cola.

Los dos padres quedan con los jóvenes hasta que son casi adultos. Los adultos dan de comer a los polluelos, pero todos los jóvenes observados se alimentaron a sí mismos. Nunca vimos más de dos adultos buscando comida juntos. Aparentemente las áreas donde viven los adultos no se traslapan.

La población de Santa Cruz parece estable. Quedan por examinar los efectos de predadores y competidores introducidos en todas las poblaciones de *Laterallus spilonotus*.

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